DOCUMENT RESUME

ED 187 945 CE 025 663

AUTHOR Dahl, Richard J.
TITLE Implications of Piagetian Theory for Early Childhood Industrial Arts: Cognitive Development. ACESIA Monograph 6.
INSTITUTION American Council for Elementary School Industrial Arts, Washington, D.C.
PUB DATE 79
NOTE 26p.; For related documents see CE 025 660-665.
AVAILABLE FROM Dr. Keith Blankenbaker, ACESIA Publications Chairperson, 190 West 19th St., The Ohio State University, Columbus, OH 43210 ($1.25)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Child Development; *Cognitive Development; Cognitive Processes; *Developmental Stages; *Early Childhood Education; Experiential Learning; *Industrial Arts; *Program Development; Vocational Education; *Young Children
IDENTIFIERS Piaget (Jean); Piagetian Stages; Piagetian Theory

ABSTRACT

The two purposes of this paper are to provide the uninitiated reader with a skeletal overview of Piaget's cognitive development theory and to identify general educational implications, especially for the development of early childhood industrial arts (ECIA) programs. The "Piaget Primer" for ECIA educators overviews such topics as (1) the four critical questions confronting those concerned with ECIA programs, namely, the what, when, why, and how of the teaching-learning process; (2) the four-stage independent concepts of Piaget's system--schema, assimilation, accomodation, and equilibrium; and (3) the four stages or periods of the stage-dependent concepts--sensori-motor intelligence, preoperational thought, concrete operational thought, and formal operational thought. The section on general theoretical implications of Piagetian theory for ECIA programs stresses the necessity for "learning by doing" and the promotion of child-centered, activity-based curriculums in ECIA programs. Seven general educational implications are outlined. (YLB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED187945

IMPLICATIONS OF PIAGETIAN THEORY FOR EARLY CHILDHOOD INDUSTRIAL ARTS: COGNITIVE DEVELOPMENT

AUTHOR

RICHARD J. DAHL
Assistant Professor
School of Education
State University of New York at Potsdam

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

1979

"PERMISSION TO REPRODUCE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

E. K. Blankenbaker

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Sponsored by

AMERICAN COUNCIL FOR ELEMENTARY SCHOOL INDUSTRIAL ARTS

An Affiliate of
The American Industrial Arts Association

CE025 663

FROM THE PRESIDENT

The American Council for Elementary School Industrial Arts, a council of the American Industrial Arts Association, was established in 1963 by forty-nine individuals who felt that industrial arts experiences should be provided as a part of the elementary school experiences of all children. Membership in the council has grown over the years and so have the services which are provided by the council to the membership. We hope that those who have been affiliated with us have also grown. This publication is designed to continue this professional growth in an effort that we may make good educational experiences even better educational experiences for our elementary children.

The purposes of the council are to:

- . . . clarify, promote and improve industrial arts and career education as a vital part of the elementary school curriculum.
- . . . coordinate, on a national level, the efforts of all who contribute to the development of elementary school industrial arts and career education.
- . . . publish materials relating to trends and issues in education for young children which will be of informational and practical use to the membership of the council.
- . . . organize action which will facilitate the general purposes of ACESIA, including the receiving, holding and administration of funds and property.

For those who wish to become affiliated with the elementary council, information may be obtained by writing to:

ACESIA Membership Chairman
American Industrial Arts Association
1201 Sixteenth Street, N.W.
Washington, D.C. 20036

COVER DESIGN BY:
Dr. James E. O'Bannon
Associate Professor
California State University—Chico

ACESIA PUBLICATIONS COMMITTEE

1977-1978

E. Keith Blankenbaker, Chairperson
The Ohio State University
Columbus, Ohio

Clarence Calder
University of Connecticut
Stores, Connecticut

Richard Dahl
State University of New York
Potsdam, New York

Arthur J. Rosser
Southwest Texas State University
San Marcos, Texas

Michael R. White
The Pennsylvania State University
University Park, Pennsylvania

PREFACE

Piaget's theories of cognitive development have been studied extensively as a means of assisting educators to understand the cognitive development of children. This publication specifically focuses on implications of Piaget's work for early childhood industrial arts. Elementary teachers, curriculum supervisors, principles, and teacher educators will find it helpful in understanding the relationships between industrial arts and cognitive development.

Monograph 5 — The Development Growth of Elementary School Students and the Role of Industrial Arts in the Process, focused on psychomotor development. Taken together, Monograph 5 and 6 provide a much broader perspective of the role and meaning of elementary school industrial arts.

Dr. E. Keith Blankenbaker
Publication Committee Chairperson

IMPLICATIONS OF PIAGETIAN THEORY FOR EARLY CHILDHOOD INDUSTRIAL ARTS: CONGNITIVE DEVELOPMENT

by Richard J. Dahl

Assistant Professor, School of Education
State University of New York College at Potsdam

Why does a child of four or five years take an Oreo cookie apart before eating it? The obvious and common reply to this inquiry is that the child is interested in eating the center filling before the wafers. Such a reply may often be confirmed by questioning a child who is engaged in the act. This act may then be appropriately labeled as an effective response or behavior. There remains, however, a cognitive explanation for this and an entire series of related behaviors. This explanation is based upon theory offering insight into four critical questions confronting those of us concerned with Early Childhood Industrial Arts Program — the *WHAT, WHEN, WHY,* and *HOW* of the teaching-learning process.[1]

The theory which offers insight into the cognitive development of young children and which suggests general educational implications for the development of early childhood industrial arts programs is that of Jean Piaget. Piaget and his Genevan collaborators have presented educators and psychologists alike with a completely new understanding of the child's mind. As Smart, Wetzstein, and Dahl (1976) explained:

> The evidence he (Piaget) raised about man's knowing has provided us with a new conceptual framework from which to view children's mental development and in turn, from which to plan educational programs more appropriately matched to the needs of children (p. 17).

How do you spell Piaget? Approximately two years ago the writer received a memorandum from a teacher requesting information concerning some "exciting games" she had recently learned about. This teacher wanted information on "Pig-A-Get" games! So how do you spell Piaget? As odd as this question may seem, the second grade teacher's memorandum points to the fact that Piaget and his views have only been generally studied by American educators for approximately twenty years. Almy (1975) confirms that between 1934 and 1959 only fifteen articles were published in the United States concerning Piaget's studies, and eight of the fifteen were published in that last year, 1959. Sixty-two articles concerning Piaget's system were published during the following decade. Today, with the enormous quantity of literature concerning Piaget's theory available, the number of educators who have not seen at least a mention of his work in the literature are now in a minority. Readers who review Piaget's writings with trepidation, however, join good company with many American educators and psychologists who find it difficult to grasp the kind of question which Piaget, as a genetic epistemologist, addresses.

---

[1] For the purposes of discussion, early childhood shall be considered to include children ranging in age from three to eight years of age, or including grade levels preschool through grade three.

This paper will be devoted to two general purposes. It will initially attempt to provide the uninitiated reader with a skeletal overview of Piaget's cognitive developmental theory—a "Piaget Primer" for the industrial arts educator concerned with programs for young children. That this introduction to Piaget's views is necessarily limited in space and intent, the interested reader is strongly encouraged to delve into Piaget's own writings as soon as possible. (Suggested initial readings are provided at the end of this work.) Secondly, this paper will attempt to identify general educational implications, from Piaget's theory, and discuss the importance of these implications to the development of early childhood industrial arts (ECIA) programs. Three of the four questions previously identified as critical to the industrial arts educator concerned with ECIA programs will serve as a specific focus within this process.

A "Piaget Primer" for ECIA Educators

The requirement in Piagetian theory that the young child must *act upon real objects and actual events,* in order to facilitate cognitive growth, will serve here as both an illustration and an "active" introdution. The ECIA activity "Introduction to Hammers" shown in Figure 1 was at one time used with a particular inner-city preschool population (Dierke and Dahl, 1971). It should be noted in this particular activity that the "purpose of activity" section is blank. The reader is strongly encouraged to spend a few minutes writing the "purpose of activity" as he/she views it at this point. In constructing this "purpose", the reader should focus on responding to the following: (1) *WHY* this particular activity is valuable for young children, (2) *HOW* the educator would present the activity (procedures, methodology, etc.), and (3) *WHEN* this activity should be provided to a young child or a group of young children. It should be noted at the onset that a "definition" of the activity is provided. For the purposes of this exercise, this "definition" will be considered the *WHAT* of the activity. Once this exercise has been completed, the reader is further encouraged to hold his/her ideas in mind for comparison as Piaget's system is explored.

Piaget and the Thought of the Young Child

Educators often mistakenly label Piaget as a learning theorist. Piaget's major concern is *not* with learning, however, but with the *development of knowledge.* A parallel error in assumption, which educators also draw, is that Piaget has a major interest in teaching. Piaget, however, has not translated his theories into specifics for curriculum development and classroom practice—let alone for teaching and learning in elementary school or early childhood industrial arts programs. He has left this task of interpretation to us, the practitioners to accomplish.

Piaget is concerned with the development of intelligence or the development of cognitive structures. He maintains that a key factor in cognitive development is its spontaneity or *that intelligence and knowledge cannot be directly transmitted or taught.* The young child *constructs* his knowledge and reality of the world through *physical interactions* in his environment. A child learns to know his world around him through his *actions* and *cognitive reorganization process.*

Piaget, a biologist from early training, initiated his work by hypothesizing that intelligence is developed through *adaptations* to one's environment over time, thus dispelling the long standing conception that child thought was the same as adult thought. Showing that the young

Early Childhood Industrial Arts Activity

Name of Activity: Introduction to Hammers

Definition:

A free activity (no specific project outcome) designed to allow for instruction in the methods, safety precautions and terms related to the proper usage of curved claw hammers.

Sketch of Activity:

(Note: Utilize a large assortment of scrap wood. There is no sketch as there is no specific project outcome with this activity.)

Bill of Materials: (Estimated for class of 15 children)

No. Req.	Name	Size/Type Materials
2 lbs.	Nails	4d Common
	Scrap Wood	Assorted Pine, Basswood, etc.

Tools to be Utilized:

1. 6 — 7 oz. Claw Hammers
2. 2 — Primary Pencils or Markers

Equipment to be Utilized:

1. Tool Cart.
2. Three Workbenches

Order of Operations:

1. Child's decision

Purpose of Activity:

WHY

HOW

WHEN

Figure 1. Early Childhood Industrial Arts Activity: Introduction to Hammers. An Exercise in Defining the Why, How, and When of Early Childhood Industrial Arts Programs.

child has a form of thought which is different than that of the adult has been lauded by many as a major contribution to educational thinking (Claparede, 1926/1955; Flavell, 1963; Inhelder, Sinclair, Bovet, 1974; Sigel & Hooper, 1968). It is extremely difficult for the majority of adults to identify with the concept that young children "think differently" than they do. As is true with early emotions and events, for example, most adults do not fully remember how they thought at the age of three, four, five, six, or seven. To illustrate this concept, refer to the "Glig" sheet illustrated in Figure 2. Consider the four frames and note that they increase in difficulty from number one through number fifteen. The majority of adults viewing this figure will have little trouble solving numbers one and six, yet it will require respectively more time to solve number eight and surely even longer to solve number fifteen. It is extremely important at this point to consider that a young child will have relatively as much difficulty solving numbers one or six as adults experience with number eight or fifteen.

Figure 2. The "Glig" sheet. From Elementary Science Study. Attribute Games and Problems. New York: Webster Division, McGraw-Hill Book Co., 1968.

This exercise with the "Glig" sheet is an attempt toward illustrating the concept that young children think differently than adults. It does not, however, illustrate *WHEN, HOW* or *WHY* they think differently. In order to focus in on this problem, Piaget's system must be considered. Piaget's theory, again, may offer insight into the four critical questions confronting those of us concerned with ECIA programs—the *What, When, Why,* and *How* of the teaching-learning process. It surely can offer an answer to the Oreo problem!

Piaget's Theory: Stage Independent Concepts

It has been previously stated that Piaget, as a biologist by early training, considers the actions of an organism as acts of *adaptation* to the physical environment. As such, he thus also views cognitive acts as the organization (or cognitive reorganization) *of* and adaptation *to* the perenvironment. This cognitive adaptation process may be considered as comprising the *stage independent* aspects of Piaget's system. Four basic concepts within the stage independent aspect of this theory must be considered: *SCHEMA, ASSIMILATION, ACCOMMODATION,* and *EQUILIBRIUM* (Flavell, 1963).

Schema are cognitive structures by which individuals adapt to and organize their environment. In a simplistic sense, schema may be thought of as mental categories. Schema are intellectural structures within which events and objects are organized into groups with common characteristics as they are perceived by the individual. At birth, schema are reflexive and include sucking and grasping. With time, such schema become more differentiated, less sensory, more numerous, and increasingly complex. Sucking, for example, may become a milk/non-milk schema. A one and a-half year old by the name of Jeffrey, having a pet dog at home, logically labeled the first horse he had ever seen as a "dog" (Wetzsteing, 1978).

Assimilation is the cognitive process by which one intergrates new perceptual matter or stimulus events into existing schema or patterns of behavior. Jeffrey, above, assimilated the horse he saw into his existing "dog" schema.

Accommodation is the process which involves the creation of new schema or the modification of old or existing schema. When a child is confronted with a new perceptual stimulus, the child attempts to assimilate it into existing cognitive structures or schema. If the stimulus does not fit into available schema the child must (1) create a new schema, or (2) modify existing schema in order that the new stimulus will fit into it. Both actions result in the development of cognitive structures.

With experience over time, for example, our Jeffrey may accommodate horse in one of many fashions. He may create a new schema "horses", or create a new schema "four-legged animals" in which he may place both horses and dogs. He may also accommodate horses through a modification of a "four-legged dogs" schema or "animals" schema.

Equlibrium is the balance between assimilation and accommodation. Whenever the child is having difficulty assimilating a new stimulus, *disequilibrium* occurs and accommodation must then occur in order to regain cognitive equilibrium. Piaget believes equilibrium is necessary to insure the efficient interaction of the developing child with his evnironment.

Jeffrey, the child of our example above, did not experience disequilibrium when he labeled or assimilated his horse as a dog until, when riding bareback, the horse whinnied loudly. Disequilibrium was then readily

observable in the form of strong emotions as Jeffrey, knowing that dogs bark, suddenly went into disequilibrium—or recognized his label or assimilation of horse as dog was drastically incorrect.

Stage Independent Concepts: An Illustration

The four concepts of schema, assimilation, accommodation and equilibrium are fundamental to the stage independent aspects of Piaget's system. The following exercise will clarify these four concepts further.

Example. If a person who is only able to read English were to read a *vital* question written in the Spanish language, the English reader would probably experience disequilibrium as that reader would be desperately attempting to assimilate the written question into a non-existent schema, or schemata within the English language only. To illustrate, read the following question:

TIENE USTED UN CALENTON EN SU CASA?

(This particular question, it should be noted, is not necessarily of *vital* importance to the reader.) Translated, the question reads:

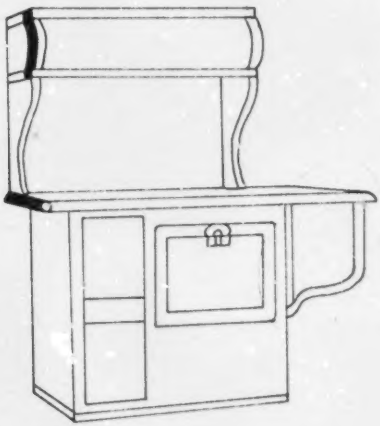
DO YOU HAVE A HOT WATER HEATER IN YOUR HOUSE?

As this question has been translated, the English language reader will be able to assimilate the message into existing schema—but also possible not! To explain, not that "calenton" refers to a type of "hot water heater" in a New Mexico region. English language readers not native to this region should feel, up to this point, quite comfortable with their respective assimilations. Each reader should also have a mental image of a "hot water heater" or "calenton". The English language reader is encouraged at this point to actually sketch his/her mental image as by doing so the concept may assume a personal meaning.

Once the reader has sketched his/her mental image of a "hot water heater" or "calenton", it should be compared with that illustrated in Figure 3. If the reader's sketch resembles that illustrated in Figure 3,

Figure 3. A common hot water heater.

he/she has joined good company as this is an image often associated with "hot water heater". Observe now, however, that if in fact a sketch approximates that shown in Figure 3, then the Spanish question *could not* be answered correctly. Figure 3, in other words, is *not* a "calenton"! With this claim, now, the reader should be experiencing disequilibrium as he/she has logically yet incorrectly assimilated "calenton" into an existing "hot water heater" schema (remember Jeffrey who also logically yet incorrectly assimilated "horse" into his schema "dog"). As the reader is now directed to look at Figure 4, one of two types of operations will occur. The operation which assumes precedence, of course, will be controlled by the readers existing schema which have formed through past experiences. The two operations which can occur include (1) the assimilation of "calenton" into existing "hot water heater" schema, or (2) existing "hot water heater" schema will be modified to accommodate the novel label and image "calenton".



CALENTÓN

Figure 4 Calenton

Stage Dependent Concepts

The *stage dependent* aspects of Piaget's theory are usually more familiar to the casual reader than are stage independent concepts. Basically, the stage dependent aspects include the famous four stages or or periods: (1) *SENSORI-MOTOR INTELLIGENCE*, (2) *PREOPERATIONAL THOUGHT*, (3) *CONCRETE OPERATIONAL THOUGHT*, and (4) *FORMAL OPERATIONAL THOUGHT* (Piaget, 1963, 1971). Thses so-called four periods of child development define Piaget's view of cognitive development as a coherent process of successive, qualitative changes of cognitive structures. The four periods are briefly discussed below, and chronological age ranges typically associated with each of the four have been included. It is extremely important to remember that the age ranges listed *are not* fixed by normative. The *order* of the stages, however, is a fixed sequence.

The Period of Sensori-motor Intelligence (0-2 years). The child's behavior is primarily motor during this period. The child is born with reflexive behaviors such as sucking, crying and grasping. Over time, reflexive behaviors are modified and become habitual, intentional and selective. At about one year, the child anticipates events, incorporates trial-and-error procedures and develops the concepts of object permanency (i.e., what is out of sight is no longer out of mind).

The Period of Preoperational Thought (2-7 years). During this period the child develops his mental imagery (ability to think symbolically) and, of course, acquires language. Cognitive behavior, though, is extremely influenced by perceptual activity (i.e., seeing is believing). The child's thinking is dominated by egocentrism. The child is unable to attend to *transformations* but rather *centers* or focuses upon states. If the preoperational child, for example, observes one push of a hand saw through a two-by-four (Figure 5), that child will typically be able to sketch or describe the saw only in its initial state (start of cut) and final state (end of cut). The preoperational child cannot attend to the transformation and therefore will be unable to sketch or describe the saw's series of successive states as it cuts through the two-by-four.

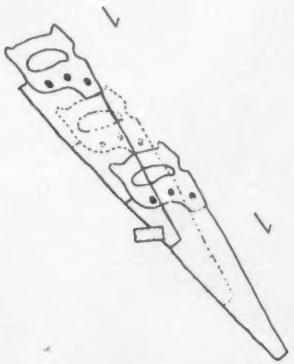


Figure 5. Example of the preoperational child's inability to attend to transformations.

The preoperational child's thinking also *centers* upon a limited perceptual aspect of a stimulus. If our preoperational child is asked to compare two rows of nails (Figure 6) in which one row contains eleven nails and the other, a longer row, contains only nine nails, the child will typically select the "longer" row as containing "more" nails. This perceptual dominance of the peroperational child occurs even though the child cognitively "knows" that eleven is more than nine.

Figure 6. Example of the preoperational child's inability to decenter perceptual events in the light of what he cognitively "knows".

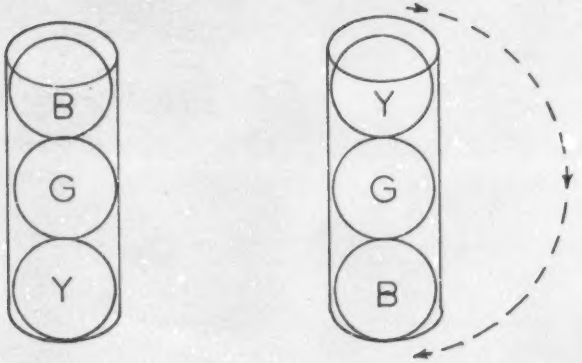
A third characteristic of the peroperational child is the child's inability to *reverse* his thought. The peroperational child, in other words, is not aware that certain attributes of an object remain invarient regardless of rearrangements or alterations made to other attributes. If the typical peroperational child, for example, observes three tennis balls colored yellow, green, and blue as they are placed in that order into one end of a tennis ball can which is open on both ends, that child will successfully predict the order by color in which the balls will emerge from the opposite end (Figure 7). If, however, the same child watches the same operation occur with the additional element added of rotating the entire can with balls inside 180 degrees (end for end), that child will typically be unable to mentally "reverse" the operation and will continue to predict that the balls will emerge in the order of color in which they were originally placed into the can.

A second example of the reversibility characteristic may be noted which further illustrates the concept that once a motor act has been accomplished, the peroperational child "knows" that it may not be reversed. Observing a section of two-by-four as it is cut from a larger section the peroperational child will typically be unable to explain that the two sections were once one. Perceptual dominance is here again a determining factor.

Lastly, a most important development of the peroperational child is the development of language. While Piaget (1967) maintains that intelligence begins to develop before language, the issue concerning the relationship between language and thought is vigorously debated (Carroll, 1964; Dahl, 1976; Sigel, 1968, Zwart; 1970, 1971). Piaget (Inhelder and Piaget, 1964) is willing to admit that language does serve an important function as a representative or symbolic means for handling objects and events. The implications for ECIA programs with the need of many educators for a "quiet" classroom are obvious here.

And what about our opening problem with the Oreo cookies? As the peroperational child functions under the conditions outlined above, including centration, transformation and reversibility factors,—the child takes the cookie apart because "there's more" when this is done!

The Period of Concrete Operational Thought (7-11 years). With entering the concrete operational stage, the child begins to make cognitively logical decisions as opposed to perceptual decisions. The concrete operational child develops the ability to decenter his perceptions and attends to transformations. Most importantly the concrete operational child attains reversibility of operations.



a.
Preoperational child will successfully predict that ball will emerge from the opposite end of tube in the same order (blue, yellow, green) as they were placed into it.

b.
Preoperational child will incorrectly predict that ball will emerge from the tube in the same order (blue, yellow, green) as they were placed into it after observing the tube with balls inserted rotate 180 degrees (end for end).

Figure 7. Reversibility Task Incorporating Three Differently Colored Tennis Balls in a Tube.

The term "concrete" here is an important one as the child is developing *logical operations.* Logical operations include *reverisbility, seriation,* and *classification* abilities. Reversibility has been discussed previously in terms of the preoperational child. The conceret operational child is developing the elaborate ability to decenter and attend to relevant transformations of an event. This developing ability allows the typical concrete operational child to mentally *negate* and *reciprocate* (although this is a duality within this period and will not function as one system of unified operations until the period of formal thought) actions perceived. The logical operation of reversibility, then, provides the concrete operational child with the knowledge that a transformed object may be returned to its original state. With all three logical operations, the term "concrete operational" is indicative of the child's need at this stage to *act* upon concrete objects and event—or, in another sense, *real objects* and *actual events.*

Seriation involves the child's ability to *order* real objects and actual events based upon a single and later multiple criterion. An example of a properly seriated task based upon the single criterion of length is illustrated in Figure 8. Note here that the blocks are seriated or ordered from shortest to longest. A typical preoperational child may be able to seriate objects on one criteria as shown here, and this ability develops through the concrete operational period.

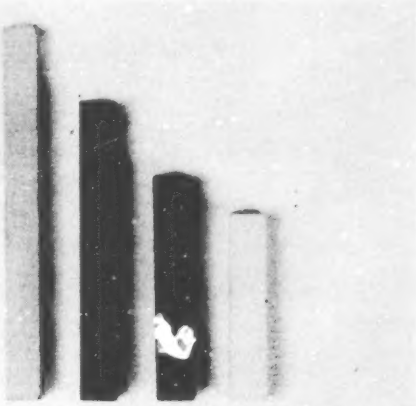


Figure 8. Seriated Blocks

The third logical operation of classification concerns the child's ability to *group* real objects and actual events based upon a single and later multiple criterion. A classification task involving a double criterion is illustrated in Figure 9. In this task, the child must understand the concept of class inclusion: the child must be able to mentally manipulate the facts that some of the blocks are pine, some are redwood, and all are wood. During this task the child is asked to say how many pine blocks there are on the table, then to say how many redwood blocks there are on the table, and then to say whether there are more redwood blocks or wooden blocks on the table. The child who is unable to process all the given information mentally, or who is unable to mentally manipulate the double criterion, will not provide the appropriate response. Classification skills become apparent at the close of the preoperational period and continue to develop through the concrete operational period.

The Period of Formal Operational Thought (11-15 years). The formal operational child may solve a larger range of logical problems than the concerte operational child. The formal operational child is also largely freed of his perceptions and may solve problems concerning the past and future as well as the present. In terms of this ability Wadsworth (1971) suggests that the formal operational child has the ability or cognitive structure to think " as well as" an adult, but that the child will not necessarily think "as good as" an adult. The implication here is that only the potential to do so has been reached with this stage.

The formal operational child holds the capacity to solve complex verbal problems, hypothetical problems and problems involving *combinatorial* thought. The adult reader should also be able to solve problems which require this cognitive exploration of all possible combinations. A problem of combinatorial thought is provided in Figure 10. If the reader were to administer this task to a child in formal operations, information concerning how the child attacked the problem could be derived through observation.

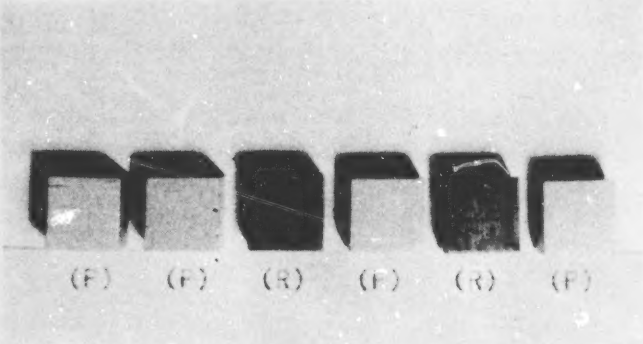


Figure 9. Classification Task.

Test Your Logic on This Brain-Teaser! !

The facts essential to solving the problem—which can indeed be solved by combining deduction, analysis, and sheer persistence—are as follows:

1. There are five houses, each of different color and inhabited by men of different nationalities, with different pets, drinks, and cigarettes.
2. The Englishman lives in the red house.
3. The Spaniard own the dog.
4. Coffee is drunk in the green house.
5. The Ukrainian drinks tea.
6. The green house in immediately to the right (your right) of the ivory house.
7. The Old Gold smoker owns snails.
8. Kools are smoked in the yellow house.
9. Milk is drunk in the middle house.
10. The Norwegian lives in the first house on the left.
11. The man who smokes Chesterfields lives in the house next to the man with the fox.
12. Kools are smoked in the house next to the house where the horse is kept.
13. The Lucky Strike smoker drinks orange juice.
14. The Japanese smokes Parliaments.
15. The Norwegian lives next to the blue house.

Now, who drinks water and who owns the zebra?

Figure 10. Combinatory Logic Problem. From: Neufield, E. *The Philosophy of Jean Piaget and Its Educational Implications*. New Jersey: General Learning Press, 1976.

If this problem were to be administered to a preoperational or concrete operational child, similar observations could be conducted, the children would be unable to consider all variables necessary and thus only solve one aspect of the problem.

The reader should attempt to solve the problem in Figure 10 remembering that children who have not yet reached the level of formal operations will not be able to completely solve this same problem. The reader should also consider that the cognitive effort exercised in solving this problem is not unequal to the mental effort of a child attempting to solve seriation and classification problems. The effort may be similar, but the cognitive structures and abilities available to the adult reader and to young children are definitely different—both qualitatively and quantitatively.

General Theoretical Implications of Piagetian Theory for Early Childhood Industrial Arts Programs

One critical aspect of Piaget's theory has influenced present day early childhood education programs as much as the concept of stages. This critical element was noted at the beginning of this paper and served as a precipitant to the inclusion of the ECIA activity "Introduction to Hammers". This critical element in Piagetian Theory, of course, specifies that children, over the course of their individual development, *actively construct* their own knowledge and reality (through the assimilation and accommodation process). As Piaget (1967) noted:

> The clearest result of our research on the psychology of intelligence is that even the structures most necessary to the adult mind, . . . are not innate in the child; they are built up little by little . . . (p. 149)

A word of caution is appropriate at this point as many educators feel that Piaget is taking over where Dewey left off. The concept of activity which Dewey and the progressive movement heralded, unfortunately, has seemingly lost its implications for cognitive development in almost all practical levels of education today except kindergarten. (It must be regretted that even many kindergartens today are losing sight of the necessity for "learning by doing" under the real pressures of the "back to basics" movement.) Hopefully the purpose of activity is better understood by followers of Piaget than followers of Dewey. As Piaget's collaborators Kamii and DeVries (1978) suggest:

> The term *action* requires clarification, as it has at least two different meanings in Piaget's terminology. The first meaning is the common which we used . . . to refer to manipulative actions on objects . . . The second meaning of action is harder to understand because the child can act upon an object without even touching it. For example, when he looks at a block and notices it as a block, he can be said to be acting on it. (p. 19)
>
> and
>
> Having argued that mental action is necessary for the construction of both physical and logico-mathematical knowledge, we would now like to add a most important condition: namely, that physical manipulation is indispensable for mental action to become possible. (pp. 19-20)

Child-Centered, Activity-Based Curriculum

If the process of knowing develops as the child actively interacts with his environment, then it follows that ECIA programs should promote *child-centered, activity-based* curriculums. Such a concept, of course, is not novel to the field of elementary school industrial arts. A review of a statement developed by the National Conference for Elementary School Industrial Arts (Hoots, 1971) will confirm that the concept concerning the manipulation of concrete objects is uniquely common to the field.

> Industrial arts at the elementary school level is an essential part of the education of every child. It deals with ways in which man thinks about and applies scientific theory and principles to change his physical environment to meet his aesthetic and utilitarian needs. It provides opportunities for developing concepts through concrete experiences which include manipulation of materials, tools and processes, and other methods of discovery. It includes knowledge about technology and its processes, personal development of psychomotor skills, and attitudes and understandings of how technology influences society. (p. 3)

A major purpose of ECIA programs must be the encouragement of mental and physical involvement in children. Four dynamic factors are involved in the development of cognitive structures. These four factors include: (1) *maturation,* (2) *experience with the physical environment,* (3) *action with the social environment,* and (4) *equilibrium.* There is little that educators may do to effect physical and neurological maturation, (save school nutriton programs), and likewise the equilibrium process is largely an individual one. Educators may, however, influence the social and physical environments which they provide young children. Through such an influence, educators may also effect the self-regulation process of equilibration—again by providing young children a maximum of activity of their own through the provision of materials which permit their activities to be cognitively useful.

The What, When, How, and Why for ECIA

Similarities between Piagetian theory and existing elementary school industrial arts philosophy, it has been noted, exist specifically in similarities concerning the concept of activity. A more obvious discrepancy may develop, however, concerning specific ECIA curriculum content. Today, with the widespread interest in early childhood curriculum development, there is a growing need for empirical data to know the effects of incorporating the many traditionally and intuitively valued industrial arts knowledges and skills at this level. The *what* of ECIA must be determined. In addition, if industrial arts is to prove viable for young children either as (1) a subject matter discipline, (2) as a partner with all units within the curriculum, (3) as integrated with other subjects, within units, or (4) as taught separately but correlated with other subjects, as Hoots (1969) suggests, then the general educational implications of the Piagetian system for ECIA must be considered— the *when, how,* and *why.* (The appropriateness of specific ECIA curiculum content, the *what,* will be explored in subsequent works.)

General Educational Implications for ECIA Programs

General educational implications derived from Piagetian theory and concerning early childhood education have been suggested (Smart, 1970; Wadsworth, 1971; Farnham-Diggory, 1972; Neufeld, 1976). The following implications have been delineated with respect to ECIA programs.

1. Provide the child with diverse opportunities to cognitively reorganize new processes, materials and equipment. A teacher assists or facilitates the activity, but remembers that young children learn through direct interaction with their environment—not by merely listening to and observing the teacher.
2. With experience (including interatction with physical tools, materials and processes in his/her environment) the child will become more sophisticated in the use of tools and materials. It is extremely important here not to confuse the product of learning with the process of learning. The teacher may have to exercise restraint in dictating form and procedure. What may appear to the adult as a few bent nails and rough-sawn board may actually represent a grand oceanliner in the child's mind.
3. The young child views his world differently than the adult does. Whether views are mentally altered or not often depends upon the nature of the activity in which the child is engaged and/or who is encountered. The necessary development of cognitive disequilibrium is largely dependent upon the child's perception of personal gain from involvement in a particular activity.
4. The question concerning the use of commercial equipment and materials in the classroom should be carefully considered. Material overload and environmental confusion are common factors leading to visual and mental distraction. Materials should be modifiable in order that the young child may adapt them to personal needs. A class of young children building wooden airplanes will rarely produce two alike when allowed to individually act upon the available materials and tools.
5. Cognitive development is dependent upon actions. Time is a necessary element to provide for cognitive reorganization processes to occur. Sorting fasteners, counting hammer blows, listening to the saw cutting through a section of wood, engaging in dramatic and symbolic lay, classifying tools by color, weight, and so on, are just a few examples of industrial arts related experiences which promote the formation of schemata or mental classifications.
6. Promote the development of expressive language. The actively interested and involved child is a potentially endless source of egocentric and social language. Adults serve vital roles as language models and by eliciting and expanding child language as well as by asking questions which promote cognitive activity and clarification.
7. Provide for adult-child and child-child interactions through pictures, processes, products, tools, materials, manipulative activities and oral language within small group experiences.

An "Introduction to Hammers"

The intent for introducing the ECIA activity "Introduction to Hammers" at the beginning of this paper should be obvious to the reader at this juncture. True to Piaget's theory, this activity was included to serve as an impetus to cause the reader to mentally act upon the theory and implications of that theory under discussion. It should be renoted at this point that the *what* of the activity was assumed (by definition but not necessarily in total alignment with the function of any activity in ECIA as

viewed from the cognitive developmental perspective). The reader is now encouraged to reflect upon the responses which he/she noted under each "Purpose of Activity" category in terms of the general implications of Piaget's theory for ECIA as discussed in this paper. While reviewing his/her responses to each of the three critical questions (when, how, and why) the reader may consider the following thoughts for each of the three respective elements.

When? Were scheduling factors such as time of day or week, frequency and duration of activities, special occasions (i.e., Christmas, Father's Day) teacher convenience, and other factors such as age-grade levels and noise levels considered? —OR—Were the cognitive developmental levels (stages) and cognitive reorganization needs (assimilation-accommodation process) of young children considered with this activity?

How? Were classroom management factors such as activity group size, place where the activity was to be conducted (i.e., contained classroom, hallway, patio, school shop), who was to conduct the activity (i.e., classroom teacher, aide, industrial arts consultant), what types of tools, materials and equipment would be needed, how the activity should be planned or sequenced, and safety considered? —OR—Was the issue of teacher-centered versus child-centered activities as it related to the cognitive developmental needs of young children considered?

Why? Were traditional categories such as career education, hand tool orientation, creativity, fine-motor and/or eye-hand coordination, and figure-ground discrimination considered? —OR—Were the physical and even social knowledge needs and cognitivie reorganization processes of young children considered?

The Consequences

With this opportunity to reflect upon perosnal industrial arts philosophies industrial arts educators are encouraged to consider the general educational implications of Piagetian theory in the future development of ECIA programs. In consideration of the four critical questions concerning ECIA programs, Piaget's theory of intellectual development *must* be translated into specific classroom practices. Roeper and Sigel (1970) maintain that the greatest obstacle to such a translation lies in the difficulty of the adult in identifying with the young child's manner of thinking. If however, curriculum developers in ECIA programs do not consider the conceptual developmental processes and needs of young children the resultant learning will be highly ineffectual and grossly inefficient.

Selected References

Almy, M. Piaget and early childhood education. Paper presented at the Fifth Annual Symposium of the Jean Piaget Society. Philadelphia, Pennsylvania, May, 1975.

Carroll, J. Language and thought. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1964.

Claparede, E. Preface. In Jean Piaget, **The Language and Thought of the Child.** New York: World Publishing, 1955. (First published 1926.)

Dahl, R. The attainment of conservation of mass and verbal synthesis between Latin-American children who speak one or two languages. Unpublished doctoral dissertation. Los Angeles, California: University of Southern California, 1976.

Dierke, J., & Dahl, R. Interdisciplinary industrial arts teacher education program development. Paper presented at the 33rd Annual Conference, American Industrial Arts Association, Miami Beach, Florida, 1971. **Industrial Arts and Space Age Technology.** Washington, D.C.: American Industrial Arts Association, 1971.

Farnham-Diggory, S. Cognitive processes in education: a psychological preparation for teaching and curriculum development. New York: Harper & Row, 1972.

Flavell, J. The developmental psychology of Jean Piaget. Princeton, New Jersey: Van Nostrand, 1963.

Hoots, W. An industrial arts curriculum for the elementary grades. Greenville, North Carolina: American Council for Elementary School Industrial Arts, 1969.

Hoots, W. (Ed.) Industrial arts in the elementary school: education for a changing society. Greenville, North Carolina: National Conference on Elementary School Industrial Arts, 1971.

Inhelder, B., & Piaget, J. The early growth of logic in the child. New York: W.W. Norton and Co., Inc., 1969. (Originally published; London: Routledge & Kegan Paul Ltd., 1964).

Inhelder, B., Sinclair, H., & Bovet, M. Learning and the development of cognition. Massachusetts: Harvard University Press, 1974.

Kamii, C., & DeVries, R. Physical knowledge in preschool education: Implications of Piaget's theory. New Jersey: Prentice-Hall, Inc. 1978.

Neufeld, E. The philosophy of Jean Piaget and its educational implications. New Jersey: General Learning Press, 1976.

Piaget, J. The psychology of intelligence. Paterson, New Jersey: Littlefield, Adams, 1963.

Piaget, J. Six psychological studies. New York: Vintage Books, 1967.

Piaget, J. The theory of stages in cognitive development. In D. Green, M. Ford, & G. Flamer (Eds.), **Measurement and Piaget.** New York: McGraw-Hill Book Co., 1971.

Roeper, A., & Sigel, I. Finding the clue to children's thought processes. Young Child, 1966, 21, 335-349.

Sigel, I., & Hooper, F. Logical thinking in children. New York: Holt, Rinehart, & Winston, 1968.

Sinclair-De-Zwart, H. Piaget's theory and language acquisition. In M. Rosskoph, L. Steffe, & S. Tarback (Eds.), **Piagetian Cognitive Development Research and Mathematical Education.** Proceedings of a conference held October 18-23, 1970. New York: National Council of Teachers of Mathematics, 1971.

Smart, M. What Piaget suggests to classroom teachers. In I. Athey and D. Rubadeau (Eds.), **Educational Implications of Piaget's Theory** Waltham, Massachusetts: Ginn-Blaisdell, 1970.

Smart, M., Wetzstein, C., & Dahl, R. The use of Piagetian derived categories to analyze children's social language during selected pre-school experiences. Paper presented at the Fifth Annual Symposium of The Jean Piaget Society. Philadelphia, Pennsylvania, May, 1975. **The Delta Kappa Gamma Bulletin,** 1976, 42 (3), 16-27.

Wadsworth, B. Piaget's theory of cognitive development. New York: Longman, 1971.

Wetzstein, C. Personal communication, May 19, 1978.

Suggested Initial Readings

Introductory only to Piaget's theroy.

Neufield, E. The philosophy of Jean Piaget and its educational implications. New Jersey: General Learning Press, 1976.

Wadsworth, B. Piaget for the classroom teacher. New York: Longman, 1978.

ORDER FORM

Please send me copies of the following ACESIA publications.*

QUANTITY ORDERED	TITLE OF PUBLICATIONS	UNIT COST	TOTAL COST
	Schools for Children	$1.25	
	Problem Solving and Technology	$1.25	
	Directory of Resource People	$1.00	
	Developmental Growth of Elementary School Students. . .	$1.25	
	Implications of Piagetion Theory for Early Childhood Ind. Arts	$1.25	
	Total Amount Enclosed		

**Please make checks payable to: ACESIA*

Mail Order Form to:

Dr. Keith Blankenbaker
ACESIA Publications Chairperson
190 West 19th Avenue
The Ohio State University
Columbus, Ohio 43210

(please allow two (2) weeks for processing and delivery)

EVALUATION

The title of the ACESIA publication being evaluated is:

_____

YES NO
( ) ( ) This is a very useful monograph.
(CHECK ONE)

If you checked YES, what did you like about the monograph? _____
_____
_____

If you checked NO, what did you not like about the monograph? _____
_____
_____

YES NO
( ) ( ) The articles were well written.
(CHECK ONE)

YES NO
( ) ( ) The articles were very timely.
(CHECK ONE)

I would recommend that a monograph be developed around the following topic(s):

A. _____
_____
_____

B. _____
_____
_____

Evaluator: _____

Level of Practice: _____

Address: _____
_____
_____

Please return this evaluation form to the ACESIA Publications Chairman who's address appears at the bottom of the following page.

ACESIA OFFICERS

President Elect
Ms. Norma Heasley
Summit Count Bd. of Ed.
482 Grant Street
Akron, OH 4431

Vice-President—Reg. Rep.
Marjorie L. Inman
1033 Melton Street
Cheyenne, WY 82001
(307) 632-7498

Vice-President—Program
Dr. F. Milton Miller
Industrial Education
University of Missouri
Columbia, MO 65201
(314) 882-2782

Secretary
Dr. Denis J. Foley, Jr.
Dept. of Industrial Arts Ed.
Millersville State College
Millersville, PA 17551
(717) 872-5411

Treasurer
D. Roger Schaefer
University of Wisconsin-Stout
Menomonie, WI 54751
(715) 232-2276

COMMITTEE CHAIRPERSONS

Membership
Dr. Floyd Walgren
School of Technology
Kent State University
Kent, Ohio 44242
(216) 672-2334

Constitution
Dr. Harold G. Gilbert
Dept. of Industry and Tech.
Northern Illinois University
DeKalb, IL 60115
(815) 753-0386

Publications
Dr. Keith Blankenbaker
Industrial Technology
Ohio State University
Columbus, OH 43210
(614) 422-2661

Educational Exhibits
Dr. Richard J. Dahl
Early Childhood C.B.T.E. Prog.
School of Education
Potsdam, NY 13676
(315) 268-2761

Budget
Prof. Dwayne Gilbert
Industrial Technology
Northwestern State University
Natchitoches, LA 71457
(318) 352-4465

Newsletter Editor
Dr. Robert D. Weber
Div. of Industrial Ed. & Tech.
Trenton State College
Trenton, NJ 08625
(609) 771-2536